AFFIRMATION AND NEGATION

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My purpose here is to report the results of four experiments dealing with the processes of affirmation and negation, and not to review or criticize the literature on the subject.[1] However, as a sort of a text or point of departure, I have chosen the following from Breese's *Psychology*, p. 323.

"In this conection we should note that the so-called negative judgments, or judgments of disbelief, are negative only in the form of language expression. The judging attitude itself is always a positive one. For instance, on seeing a counterfeit bill, I may exclaim, 'It is not good'. The judgment here consists in my acceptance of the represented content as 'not good'. This acceptance is psychologically a positive attitude, although the expressed form is negative. The judgment involved in the sentence 'The table is not round' is my positive acceptance of 'not-roundness' as an attribute of the table. Psychologically there are no negative judgments any more than there are negative perceptions, or images, or memories. It is only from the logical point of view that judgments may be called negative, and then only because of their external form."

The four experiments to be described in this report were devised to test this theory regarding negation, a theory which one finds expressed frequently in logical and psychological literature. Stated briefly, these experiments were:

I. Reaction-times: colors. Colored cards were shown in an exposure apparatus, the subject being instructed to move a lever in one direction if the color were red, for example, and in the opposite direction if the color were not red.

II. Cancellation of letter groups. Printed sheets containing 100 groups of four letters each were handed to the subjects. On some they were to cancel those groups containing specified letters, on other sheets those groups in which none of the specified letters appeared.

III. Reaction times: multiplication equations. Multiplication equations were typewritten on cards to fit the Ach exposure apparatus. The subject was instructed to move the reaction-lever in one direction when the answer was correct and in the opposite when it was incorrect.

IV. Cancellation of paired letters. 225 pairs of letters were mimeographed on each of the five sheets given to each subject. On some they were to cancel those pairs in which the two letters were the same, on others those pairs in which the two letters were different.

EXPERIMENT I.

A reaction-time set-up of apparatus was used in this experiment. It included an Ach card-exposure apparatus for 4 x 8 cm. cards, a Hipp or pendulum chronoscope, and a special reaction

[1] A brief bibliog raphy is given at the close of this article.

instrument so made that movement of a lever either to the right or to the left would either make or break the circuit, as desired. Several different sets of cards were used, each of which contained fifty cards of some one color, and ten each of five other colors.

The one color which appeared fifty times in the set was shown to the subject, who was instructed to react in one way whenever that color appeared and in the opposite way whenever any other color appeared. These other colors were not named. The subject was told that half of the cards were of the color shown him. These cards were shuffled together in the presence of the subject, but behind the exposure apparatus. With several of the subjects several different sets were used, on different days. In half of these experiments the positive[2] reactions were to the left and the negative to the right; in the other half this relation was reversed.

Results. The average reaction times for the positive and negative reactions and the differences between them are shown in Table I. Results are given for each day's work with each subject. While there was naturally some variability in the reaction time for each subject, the results are so uniformly in favor of the positive reactions that it was not thought necessary to compute any measure of variability.

These results furnish fairly conclusive evidence that the positive reactions take place more quickly than the negative. When red, for example, is the positive color, the processes including the appreciation of red and the appropriate reaction take place more quickly than those which include the appreciation of some other color as not red and the appropriate reaction.

TABLE I

AVERAGE REACTION TIMES, IN SIGMA

Subject	Positive	Negative	Difference (N–P)
Spr	328	400	72
Spi	317	424	107
..	284	386	102
..	266	325	59
..	245	370	125
..	276	363	87
Pee	369	469	100
..	364	458	94
..	360	451	91
Thi	321	403	82
..	355	374	19
Kuh	280	281	1
And	389	412	23
Gri	320	336	16

[2]Reactions to the one specified color will for convenience be referred to as "positive" reactions, and reactions to the other colors as "negative" reactions. The colors may also at times be called the "positive" and "negative" colors.

The introspections show great individual differences with regard to the method of fixing the instructions in mind and also with regard to the attitude toward the problem itself. For example, one subject made two reactions in succession when negative colors were shown, and this caused her to focus her attention for some time on the negative reaction. Her adjustment during the fore-period was so favorable to the negative reaction that results for the rest of the experiment showed shorter reaction time for the negative reactions.

At first there is a tendency to keep the positive color in mind, verbally or otherwise. The retention of the instructions as a whole may be wholly in verbal terms, in a combination of verbal imagery and kinaesthesis (arm and hand), or in a combination of visual imagery of the positive color and kinaesthesis. As the experiment proceeds there is a tendency for the instructions gradually to fade from consciousness, the reactions becoming more and more automatic. However, the adjustment of the nervous system probably remains much the same, so long as the subject does not notice just how many and just what the negative colors are.

There seems to be a positive relation between the tendency to visualize the positive color and the difference between the positive and negative reactions. Subject Spi has exceptionally clear and projected visual imagery. He reported that during the fore-period there was nearly always an image of the positive color projected to the slide covering the cards.

No concrete visual image of "not-red" was ever reported.

Psychologically, it seems to make little, if any, difference whether the consciousness that blue is not red, and therefore to be reacted to in a certain way, be verbalized as "this is not-red" or "this is-not red." Psychologically, either is a negation, at least so long as there are several not-red colors. The starting point in either the positive or the negative reaction is with "redness." "Red," particularly for the concrete-minded individual like Spi, is the "idea in mind." If the color shown is the same as this idea in mind, the judgment or perception—let us not quarrel over terminology for the present—may be regarded as positive, affirmative, or one of similarity. If the color exposed is not red, or not-red, the starting point is still with regard to red or redness, with a consciousness that the color when it appears is not in the class of reds.

Neurologically, this means that there is a definite adjustment beginning with the processes involved in the appreciation of red, and leading over to the appropriate reaction, so that when red appears the action takes place automatically, or almost so. But since each of the colors is specific, and since "not-redness" cannot be represented concretely, there can be no

complete sensori-motor adjustment for the negative colors. The adjustment on the motor side may be as complete, but not on the sensory side.

I suppose that no one would deny that there is some sort of retinal-cortical reaction of a certain more or less specific nature involved in the perception of red as red, and that the sensori-motor adjustment involved in reacting to red includes this retinal-cortical reaction or process. I believe it probable that the reactions to the negative colors under the conditions of this experiment must also involve this same process. If, during an experiment, something were suddenly to happen to this red-perceiving process, it is likely that it would prevent correct reactions to either red or not-red stimuli.

In opposition to the above interpretation or explanation of the results of this experiment it is possible that they are due, in part at least, to the fact that there were five times as many reactions to the one "positive" color, as to any one of the "negative" colors, and that during the course of the experiment there was a gradual development of specific reaction-habits to each color. If so, it is obvious that the mechanization of the sensori-motor processes starting with and including the appreciation of the positive color would take place more rapidly.

To modify this experiment in a way that would enable us to determine whether the results reported above are the result of, or affected by, the formation of any such specific reaction-habits, it would be necessary to meet two conditions. It would be necessary to have, first, as many of each of the "negative" colors as of the one "positive" color; and secondly, the total number of positive and negative reactions would have to be the same. It is obvious that this would be impossible. Other practical difficulties arise when one starts to work with a number of different colors all to be regarded as positive and an equal number to be regarded as negative. These two conditions, however, were met in the next experiment.

Experiment II.

My purpose in this experiment was to determine whether the correct explanation of the results of Experiment I was made, or whether those results were due to the establishment of reaction-habits to each of the colors used. To do this, it is necessary (1) that the number of positive and negative reactions be the same, and (2) that the number of elements to be regarded as positive be equal to the number of those to be regarded as negative.

Two carefully mimeographed forms were prepared, each having 5 columns of 20 groups of letters, each group containing 4 letters. Only 8 letters appeared on any one form, and different letters were used for the two forms. Each column in the first form contained 4 groups composed of the letters B R D X, in different orders, and 4 groups composed of the letters N J S T; 4 groups containing three of the first group of letters and one of the second; 4 groups containing two letters of each; 4 groups containing one of the first and three of the second. Taking the whole page into consideration, each letter appeared an equal

number of times. Each letter also appeared an equal number of times in each of the 4 positions in the groups. There were some slight deviations from the last two of the above rules, on account of the fact that there were only 8 letters and 100 groups. The groups in each column appeared in chance order. There was double spacing between the letters in the group, and between successive groups in the columns. To illustrate the nature and arrangement of this material, the groups in the first column were as follows:

D N X J	D S T R	B D R X	B S J N	T N J D
B D X T	D R X B	N R T S	T S J N	S J T N
S J D T	T N J S	R B X D	R X B D	D R J X
B J R X	J T S N	S D X B	S X R N	S R B J

No two groups were identical; at least the order was different.

The second form contained the letters H Z C K and L F M P. The general arrangement was the same as in the other form.

The experiment was divided into four parts, in each of which both forms were used. In Part A, the instructions for the use of the first form were: "When I say 'start', turn over the first sheet, and working by columns, cross out every group of letters which contains all four of these letters B R D X. (These letters were then written on the blackboard.) Work as rapidly and accurately as you can. After 45 seconds I shall rap on the table, and you will then turn immediately to the second sheet, and on this sheet cross out all those letters which contain none of the letters named." Then the next form was used, the instructions being the same with the exception that on the first sheet the subjects cancelled the groups which did not contain any of the letters H Z C K, and the second sheet those which contained all those letters.

With the second group of subjects this whole procedure was reversed.

Part B. The same forms were used, but the subjects were given only three letters to keep in mind, these being R B D for the first sheet and C H K for the second.

Part C. In this part only two letters were given, these being B X for the first, and K Z for the second form.

Part D. Here only one letter was given. This was the letter D for the first form, and the letter H for the second.

With the first group of subjects these different Parts were given in order just the reverse of that in which they are described above, Part D being given first and A last. With the second group this order was followed for the first half of each Part, and reversed for the second half. Yet, for any one of the Parts, the order, neglecting interpolations for the first group of

subjects, was I–P, I–N, II–N, II–P, I and II referring to the form used, and P and N to the nature of the instructions. With the second group the order was I–N, I–P, II–P, II–N.

For convenience, in what is to follow, the groups of letters containing all the letters given in the instructions will be called "positive" groups, and those which contain none of these letters will be called "negative" groups. The cancellations of these groups will also be referred to as "positive" and "negative."

In each of the four Parts, the number of possible positive and negative reactions was the same.

Not only was the number of positive and negative reactions the same, but, in Part A, as the vision was directed successively to one after another of the groups, the four letters given in the instructions and to be regarded as positive would appear the same number of times as the other four letters; and altogether, each letter would appear the same number of times as any other letter. The results of Part A are therefore more conclusive than those of the other three, so far as the interpretation of the results of Experiment I may be concerned.

With the first group of subjects each work period was of 30 sec. duration, while for the second group it was 45 sec. To make the results more directly comparable with each other and with the results of the other experiments the scores for each group were recorded in terms of the number of groups inspected, omissions, and errors per minute.

Results. The averages of the results for the two groups of 42 subjects are shown in Table II.

Little comment is needed. It is evident that the presence of a letter or of a group of letters, even with the order changed, is more quickly detected than the absence of these same letters from a group. These results seem to justify the explanation offered for the results of Experiment I; and, if so, that explanation would apply here as well as there. In fact, I cannot see how the results of this experiment can be explained in any other way.

TABLE II

CANCELLATION OF LETTER GROUPS: AVERAGE SCORES PER MINUTE

Part of exper.	Positive Instruction			Negative Instruction		
	Speed	Omissions	Errors	Speed	Omissions	Errors
A	88	1.06	.10	53	.45	.70
B	62	.41	.03	50	.36	.46
C	77	1.33	.22	62	.39	.45
D	104	2.65	.37	72	.21	.31
Average	83	1.36	.18	59	.35	.48

The subjects were asked to write out their introspections, but this proved to be a pretty hard task, as they had had little or no training in introspection, and nothing was said beforehand regarding the purpose of the experiment and they were not warned that introspections were to be called for. Since I was mainly concerned with the objective results, I did not care to run the risk that the setting of an introspective task might interfere with the work itself, which I wanted to be as free and natural as possible under the conditions of the experiment.

Almost without exception, the subjects reported that it seemed easier to detect the presence than the absence of a letter or group of letters. As to the reason for this, many said that the letters they were looking for seemed to stand out more clearly than the others, that they seemed to catch the attention more quickly. In Part D, where just one letter was given in the instructions, some of these subjects reported that the letter they "were looking for seemed to stand out, while the other letters in the group were not noticed." The explanation for this is of course to be found in the nervous basis of attention; that is, in an adjustment of the nervous system to facilitate the reception of the stimulus corresponding with the "idea in mind."

An interesting fact appears in the relative number of omissions and of wrong cancellations under the two working conditions. There are more omissions and fewer wrong reactions under positive instructions. Not only that, but under positive instructions there are more than seven times as many omissions as errors, while under negative instruction there are generally more errors than omissions.

Experiment III.

The apparatus used was the same as that of Experiment I. A multiplication equation, $9 \times 4 = 36$, for example, was typewritten on each of the cards, 4 x 8 cm., cut to fit the Ach card-exposure apparatus. On half these cards the answer given was wrong. Great care was taken to insure equal average difficulty of the equations with and without correct answers. In half the experiments the subjects moved the stick to the right when the answer was correct, and to the left when the answer was incorrect. In the other half the procedure was reversed. The subjects were told that half the answers were correct. The cards were shuffled together in the presence of the subject. There were 125 cards in the set, and none of the two left-hand members of the equations was larger than 9.

When the answer was wrong, it was always wrong by just one point, and for one-half it was larger, and for one-half smaller, than the correct answer.

In his introspective study of the process of negation, Wolters[3] used arithmetical equations in which there was a great difference between the given and the correct answers. He did not measure reaction times.

Results. The results are presented in Table III. They furnish rather conclusive evidence that it is easier to perceive the correctness than the incorrectness of the right-hand member of a multiplication equation. The situation confronting the subject and determining his attitude and adjustment in the fore-period is different from that in the preceding experiments, for in them each successive color or group of letters was judged with reference to a certain specified color, letter, or group of letters. In this experiment some of the subjects at first repeated (inner-speech) the substance of the instructions just before the card was exposed. This inner-speech repetition of the instructions tended to disappear as the experiment progressed.

During the mid-period (between the exposure of the card and the reaction) some subjects reported a tendency to read the equation with an inner-speech accompaniment. Many times the inner-speech recitation of the answer was not completed, although it might be begun. If the answer on the card was the number learned and associated to the two left-hand members of the equation, the whole process including the appropriate reaction seemed to take place smoothly and with little effort.

Some subjects report no inner-speech at all during the mid-period. One subject, Spi, reported some visual images of the correct answer to the equation in those cases where the answer on the card was wrong.

TABLE III

AVERAGE REACTION TIMES IN SIGMA

Subject	Positive (correct answers)	Negative (incorrect answers)	Difference (N-P)
Spi	1074	1341	267
...	1039	1439	400
Thi	1126	1270	44
Kuh	1010	1060	50
...	911	988	77
Gri	685	865	180
Students' results[4] Av. 21 subjects	913	1058	145

[3]Wolters, A. W., The Process of Negation, *Brit. Jour. of Psychol.*, 8, 1915, 183-211.

[4]These results were obtained by students working under my immediate direction and observation. Since I carefully refrained from any expression of opinion as to what the results might show, the results are probably fairly reliable. The differences ranged from 31 to 377 sigma in favor of the positive reactions.

When the answer on the card was wrong, there seemed to be a momentary confusion or disturbance. At least the whole process up to and including the initiation of the reaction seemed not to take place so smoothly and readily as when the answer is correct.

As with the preceding experiments, for our present purpose it makes little difference what we call the mental process involved in determining whether or not the answer on the card is correct. Looked at in slightly different ways, it might be regarded as one of affirmation and negation, as positive and negative judgment, or as the judgment or perception of similarity and difference (or of identity and difference), since it is largely a matter of comparing the given with the correct answer. Considered in this way it really makes little difference whether we say "36 is-not 35" or "36 is not-35." From either the psychological or neurological point of view either is a formal verbal statement of negation, or of a judgment or perception of dissimilarity or non-identity. However stated, the process is more complex than that which might be formally stated as "36 is 36."

If we assume that there is a set of cortical elements or paths, or some cortical process, which is functionally related to our consciousness of "36" (and its meaning), I believe it would be probable that the sudden elimination of this process would prevent a correct reaction whether the card showed "9 x 4 = 36" or "9 x 4 = 35." The mental processes preceding the reaction to the last card would be more complex, on this assumption, since they would include not only the "36" process but the "35" as well. This greater complexity would then explain the longer time required.

However, apart from any particular explanation which may or may not be valid, the bare results themselves furnish evidence that affirmation and negation are not the same; that they are not merely "two sides of the same process," as some one has said. From the standpoint of the action of the nervous system, it is not true that all negation is affirmation.

Experiment IV.

This experiment is one dealing more with similarity and difference than with affirmation and negation. But since these two problems are closely connected I decided to include this with the other experiments.

Some experimental work on this problem has been done. Most of it has been along the same general lines as that done by Hollingworth[5], who had his subjects arrange specimens of hand-

[5]Hollingworth, H. L., Judgments of Similarity and Difference, *Psychol. Rev.*, 20, 1913, 271.

writing in order of similarity and of dissimilarity in respect to a standard. Among other results, he found greater variation in the different arrangements in order of dissimilarity than in the other arrangements. It is not my purpose here to review or criticize the experimental work on this problem. Some of the results obtained by other investigators agree and some disagree with those obtained by Hollingworth. A list of references may be found at the close of this article.

Method. The subjects in this experiment were given carefully mimeographed sheets each of which had nine columns of twenty-five pairs of letters each. The letters used were: A, B, D, E, H, I, K, L, M, P. In half the pairs in which A appeared at all it was in first position, and in half in the second. There were ten pairs, both A's; ten pairs with A in first place and some other in the second place; and ten pairs with A in the second position and some other letter in the first. The same general rules apply to the appearance of each of the other letters.

The pairs appearing in the first column will illustrate the material used. These were:

I B	P D	B B	C C	M M
D D	P P	H I	K K	P P
E E	M I	I I	L A	C C
M L	E L	L K	K K	M H
P A	P L	A A	A D	K D

Each subject was given five of these sheets, stapled together. The instructions were: "Turn over the bunch of papers, and on the first sheet mark 'S' at the top of the first column, 'D' at the top of the second, 'S' at the top of the third, and so on, writing 'S' and 'D' alternately at the top of the nine columns. Now turn the sheets face downward again. When I say 'Start', turn the bunch over and, beginning at the top of the first column, cancel all the pairs of letters in which the two letters are the same. When I strike the table, stop working in that column and begin at once at the top of the second column, cancelling the pairs of different letters. Then at the next signal start at the top of the third column, cancelling those that are the same, and so on until the last column has been finished. Are there any questions? Ready. Start." After this page had been finished they were asked to turn the sheets face downward again. The instructions for the rest of the experiment were: "When I say 'Start' turn to the second sheet, and cancel all the pairs in which the two letters are the same. When I strike the table, turn to the second sheet and cancel the pairs of letters not the same; at the next signal turn to the third and do the same, that is, cancel those not the same; at the next signal turn to the next sheet and cancel the pairs that are the same. To help you re-

member which to cancel, when I give the signal each time I will say 'Same' or 'Different'. You will be allowed 60 sec. for each sheet. Ready. Start." Two sec. were allowed each time for turning over the sheets. Two groups of subjects, 42 altogether, were used, the procedure being the same with the exception that the order, exclusive of the introductory or practice sheet, with the first group was S–D–D–S while with the second it was D–S–S–D.

Results. The results of the introductory sheets were not scored for the reason that too many subjects finished each column within the 10 sec. interval allowed.

Table IV shows the scores for speed, omissions,and wrong cancellations or errors. The speed scores represent, not the number of cancellations, but the average number of pairs in-

TABLE IV

AVERAGES OF TWO ONE-MINUTE WORK-PERIODS

	Letters the same			Letters different		
Group	Speed	Omissions	Errors	Speed	Omissions	Errors
1	145	5.12	.17	117	.67	.49
2	138	5.10	.15	119	1.10	.45
Average	141.5	5.11	.16	118	.89	.47

spected per minute in the two periods in which the task was the same. These results show beyond a doubt that under the conditions of this experiment it is easier to determine or perceive the identity than the non-identity of the two letters in each pair, or at least that the former process takes place more quickly. There were no individual exceptions to this rule. With reference to the dispute whether judgments of similarity or of difference are more easily made, we can say at least that identity is more quickly perceived than the degree of difference existing between the letters used in this experiment.

It is rather difficult to offer a satisfactory explanation of these results. If, or whenever, there is a tendency to look at one of the letters of the pair a fraction of a second before the other, the explanation would be essentially the same as for the results of the other experiments. However, I am by no means sure that there is any such tendency. It may be that this is just one of the two or more factors all tending to produce the same result—if so, there would doubtless be individual differences in the relative importance of these different factors. Introspections might then be expected to differ.

Nearly all of the subjects stated that when they were canceling letters which were the same these pairs seemed to stand out more clearly than the others. Others went further and

stated that the main factor seemed to be a similarity or symmetry of outline, and that they hardly noticed what the letters were. When canceling pairs of letters that were different, some stated that they looked for these pairs, while others stated that they seemed to look for the pairs of identical letters, canceling those pairs which did not meet the requirements. Whatever else may be involved, we are probably safe in assuming that there is a greater or more wide-spread and complex cortical activity involved in the perception of "AK" than of "AA."

The results of this experiment also agree with those of Experiment II, in that there are more omissions but fewer wrong cancellations under positive instructions. These differences are in themselves conclusive evidence of a real psychological difference between the two working conditions, whatever they may be called. They also point to a similarity between the mental processes in these two experiments.

Summary

1. In the first experiment colored cards were shown, the subjects being instructed to move a lever in one way if the color were of a certain kind, in another way for any other color. The positive reaction times were, on the average, shorter than the negative.

2. It is easier to cancel groups of letters which contain certain letters than it is to cancel groups which do not contain these letters. 40 percent more work is done under positive than under negative instruction. There are fewer omissions but more wrong cancellations under negative instruction.

3. It does not require so long a time to determine the correctness of the answer in a multiplication equation as it does to determine the incorrectness of the answer. The average difference in time for the problems used was 145 sigma.

4. It is easier to pick out pairs of identical letters than pairs of different letters, where these two sorts of pairs are mixed together on a page. This difference is represented by the ratio 142:118.

5. These results indicate that the statement frequently made, that all negation is affirmation, is not true from the standpoint of the psychological and neurological processes involved.

BIBLIOGRAPHY

1. Breese, B. B., Psychology. 1917.

2. Brown, W. The Judgment of Difference. *University of Calif. Publ. in Psych.*, Vol. I, No. 1. 1910.

3. Claparède, E. La conscience de la ressemblance et de la différence chez l'enfant. *Arch. de Psych.*, 17, 1919, 67-68.

4. Dearborn, G. V. N. Notes on the Discernment of Likeness and Unlikeness. *Jour. Philos. Psych. Sci. Meth.*, 7, 1910, 57-64.

5. Downey, J. E. Preliminary Study of Family Resemblance in Handwriting. Bull. No. 1, Dept. of Psych., Univ. of Wyoming, 1910.

6. Feingold, G. A. Recognition and Discrimination. *Psych. Rev. Monog. Suppl.*, 9, 1915. No. 84.

7. Geissler, L. R. Analysis of Consciousness under Negative Instruction. *Amer. J. of Psych.*, 23, 1912, 183-312.

8. Hollingworth, H. L., Judgments of Similarity and Difference. *Psych. Rev.*, 20, 1913, 271-289.
This article and that by Strong and Hollingworth were reprinted in *Archives of Psychology*, No. 29, 1913.

9. Langfeld, H. S. Suppression with Negative Instruction. *Psych. Bull.*, 7, 1910, 200.

10. Langfeld, H. S. Voluntary Movement under Positive and Negative Instruction. *Psych. Rev.*, 20, 1913, 459-478.

11. Strong, M. H. and Hollingworth, H. L. The Influence of Form and Category on the Outcome of Judgment. *Jour. Philos. Psych. Sci. Meth.*, 9, 1912, 512-520.

12. Taylor, A. H., and Washburn, M. F. The Source of Affective Reactions to Fallacies. *Amer. J. of Psych.*, 21, 1910, 157-161.

13. Wolters, A. W. The Process of Negation. *Brit. J. of Psych.*, 8, 1915, 183-211.